* START LOOKING OVER YOUR TEST

* Get out Extra Credit to turn in

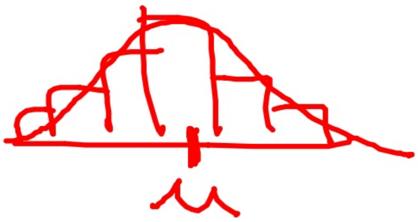
Activity from Friday... what did we learn?

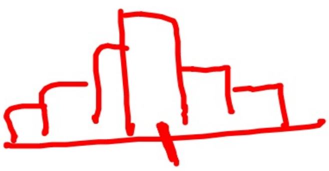
$n = 5$ vs. $n = 20$

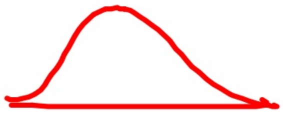
- larger n $\Rightarrow$ smaller std de

$\Rightarrow$ more accurate center

$\Rightarrow$ more normal







WARM UP:

The weights of Labradors follow a normal model with a mean of 42 lbs. and std. dev of 3.4 lbs.

1. Draw the normal model using the 68-95-99.7% rule.
2. What is the probability that you have a dog that weights more than 50 lbs? $P(X>50)$
3. What is the probability that you have a dog that weights less than 53 lbs? $P(X<53)$
4. What is the probability that you have a dog that weighs between 41 and 48 lbs? $P(41<X<48)$

Ch. 18: Central Limit Theorem

Sampling Distribution-

n=5
n=20

* A histogram of repeated samplings
* We can make histograms of means or of proportions
* Examples: true % males taking the SATs
  ~~% of foam pieces in bag~~
  true avg. score on SATs
* We use these histograms to help us find the TRUE mean or proportion

CENTRAL LIMIT THEOREM:

* A sampling distribution can be approximated by a Normal model

$np \geq 10$
nq

* The larger the sample, the better the approximation will be

Ex: binomial

* Does not matter what shape the population is... if the sample size is large enough, the sampling distribution will be Normally shaped

$\bar{x}$ $\hat{p}$

PROPORTIONS:

A sample of size n is taken from a population with center *p.*

$\hat{p}$ = sample prop.

Sampling distribution of sample proportions ($\hat{p}$):

Mean: $\mu_{\hat{p}} = p$ Std. Dev: $\sigma_{\hat{p}} = \sqrt{\frac{pq}{n}}$

The distribution is: $N\left(p, \sqrt{\frac{pq}{n}}\right)$

* According to the CLT, the sample size must be large enough for the sampling distribution to be approx. normal. The following conditions must be met:

1) Simple Random Sample (SRS)

2) np and nq ≥ 10

3) population $\geq 10n$ independence (10%) rule

Example:

According to the manufacturer of the candy Skittles, $\boxed{20\%}$ of the candy produced is the color red. What is the probability that given a large bag of skittles with 58 candies that we get at least 17 red?

Check

1. SRS assumed
2. $np \geq 10$ $\quad 58(0.2) \ngeq 10$
   $nq \geq 10$ $\quad 58(0.8) \checkmark$
3. $pop \geq 10n$ $\quad$ skittles $\ngeq 580$ $\checkmark$

normal model

$$N\left(0.20, \sqrt{\frac{(0.2)(0.8)}{58}}\right)$$

$$P\left(\hat{p} > \frac{17}{58}\right) = 0.0381$$

MEANS:

A sample of size n is taken from a population with center μ and std. dev. of σ

Sampling distribution of sample means ($\bar{x}$):

Mean: $\mu_{\bar{x}} = \mu$ Std. Dev: $\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}}$

The distribution is: $N\left(\mu, \frac{\sigma}{\sqrt{n}}\right)$

* According to the CLT, the sample size must be large enough for the sampling distribution to be approx. normal. The following conditions must be met:

1) Simple Random Sample (SRS)

2) $n \geq 30$ or the **population** must be normally distributed

3) population $\geq 10n$

Example:

* Suppose that male seniors have a mean score of 1200 with a standard deviation of 130. We take a random sample of 100 male seniors.

μ σ

① SRS stated

② $n \geq 30$ $\quad 100 \geq 30$

③ pop $\geq 10n$ $\quad$ male seniors ≥ 1000

(a) What would the distribution of sample means look like?

$$N\left(1200, \frac{130}{\sqrt{100}}\right)$$

(b) What would be the probability that we would get an average of less than 1150?

$$P(\bar{x} < 1150) = 6 \times 10^{-5}$$

p. 434

#15

#37

HW answers:

15 $p = 0.07$

$n = 200$

a) $\mu_{\hat{p}} = p = 0.07$

$\sigma_{\hat{p}} = \sqrt{\frac{pq}{n}} = \sqrt{\frac{0.07 \cdot 0.93}{200}} = \underline{0.018}$

b) 1 SRS ? assume

2 np, $nq \geq 10$ ✓

3 $pop \geq 10n$ ✓

$N(0.07, 0.018)$

c) $P(\hat{p} > 0.10)$

37) $N(266, 16)$

a) $P(270 < X < 280) = 0.211$

b) 

invnorm(0.75, 266, 16)

$P(X > ?) = 0.25$

276.792 days

c) $n = 60$

1) SRS ? assume

2) norm pop ✓ or $n \geq 30$

3) pop $\geq 10n$ ✓

$N\left(266, \frac{16}{\sqrt{60}}\right)$

ⓓ $P(\overline{X} < 260)$

normcdf$(-E99, 260, 266, 16/\sqrt{60})$

0.0018

Book problems:

p. 434 $\underbrace{\#16, 20, 22}_{\hat{p}}$, $\underbrace{38, 48}_{\bar{x}}$

1. write model & important info

   $N(\_\_\_, \_\_\_)$

2. check conditions/assumptions

   state & check

   $\begin{matrix} np \\ nq \end{matrix} \geq 10 \qquad \begin{matrix} 100 \\ 55 \end{matrix} \geq 10$ ✓

16) p = 0.30 n = 100

(a) (1) SRS stated

(2) $np \geq 10$ $30 \geq 10$

$nq \geq 10$ $70 \geq 10$

(3) pop $\geq 10n$ over 1000 people wear contacts

N(0.30, 0.0458)

(b) P(p > 1/3)= normcdf(0.3333, E99, 0.30, 0.0458) = 0.2336

20) p = 0.44 n=244

$\boxed{N(0.44, 0.03)}$

(1) SRS assumed

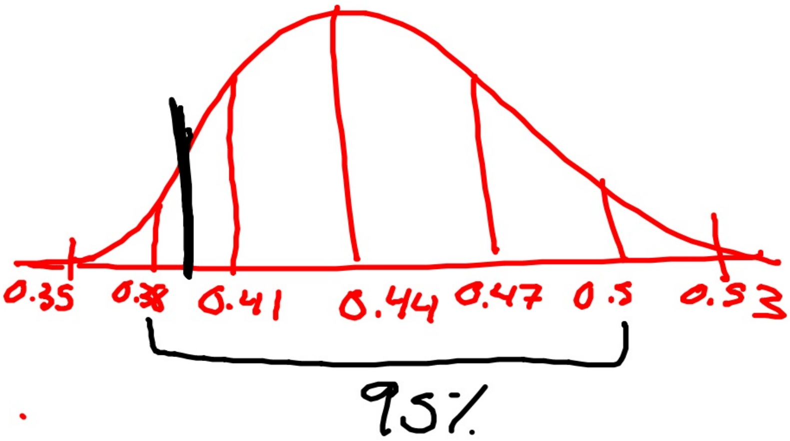
np ≥ 10 107.36 ≥ 10

nq 136.64

pop > 10n there are more than 2440 binge drinkers

$$\hat{p} = \frac{96}{244} = 39.3\%$$

$$N(0.44, 0.03)$$



22 $p = 0.92$
$n = 160$

1 SRS assumed

$np \geq 10$ $147.2 \geq 10$ ✓
nq 12.8

pop ≥ 10 more than 1600 seeds ✓

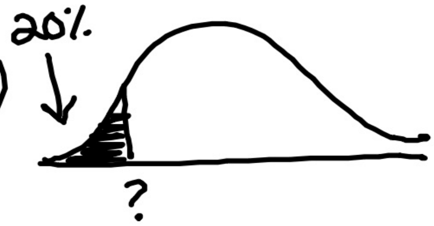
$N(0.92, 0.0214)$

$P(\hat{p} > 0.95) = 0.0805$

38 a $N(35.4, 4.2)$

$P(x>40) = 0.1367$

b



$P(x<?) = 0.20$

invnorm(0.20, 35.4, 4.2)

= 31.87"

ⓒ $n = 4$

① SRS assumed

② norm pop normal pop. stated

or

$n \geq 30$

③ pop $\geq 10n$ more than 40 yrs w/ rain ✓

$$N\left(35.4, \frac{4.2}{\sqrt{4}}\right) \Rightarrow N(35.4, 2.1)$$

ⓓ $P(\bar{x} < 30) = 0.0051$

48 $N(10.2, 0.12)$

a $P(X < 10) = 0.0478$

c $n = 3$

1 SRS ✓

2 norm pop ✓

3 pop $\geq$ 10n more than 30 bags ✓

$N\left(10.2, \frac{0.12}{\sqrt{3}}\right)$

$P(\bar{x} < 10) = 0.0019$

ⓐ $P(\overline{X} < 10)$

$N\left(10.2, \frac{0.12}{\sqrt{24}}\right)$

ⓑ $P = 0.05 \leftarrow$ under

$\underline{0.95} \cdot \underline{0.95} \cdot \underline{0.95}$